

PATENT CLAIMS

1. A method for the controlled separation of a dispersion of an aqueous solution and organic solution formed in the mixing section of an extraction step into their own phases during metal recovery in the separation section of a liquid-liquid extraction process, **characterised in that** the dispersion fed into the separation section is conducted into an outward flow field of said section, which field is formed by means of partition walls in the separation section, and in which field the phases that have separated from the dispersion are made to flow substantially in the direction of the longitudinal axis of the separation section, but the dispersion remaining in the middle of the separated phases is dammed up by means of a reversing element placed in the rear part of the outward flow field extending from one partition wall of the separation section to the other, after the reversing element the direction of the dispersion and separated solution phases is reversed in the rear of the separation section in substantially the opposite direction to flow back in the return flow fields situated on both sides of the outward flow field towards the feed end of the separation section, where the separated solutions are removed from the separation section.
2. A method according to claim 1, **characterised in that** the direction of flow of the dispersion and the separated solutions is substantially reversed in the front end of the return flow field, in the rear end of the settler, to be parallel with the longitudinal axis of the settler by means of picket fences.
3. A method according to claim 1 or 2, **characterised in that** the cross-section of the flow fields decreases constantly in the direction of flow.

4. A method according to one of claims 1 - 3, **characterised in that** the length of the partition walls is 85 – 95% of the length of the settler.
5. A method according to one of claims 1 - 4, **characterised in that** the reversing element comprises of at least two plate-like components, and that in the reversing channel between them the direction of the dispersion is turned to be substantially vertical.
6. A method according to one of claims 1 - 5, **characterised in that** the upper edge of a first plate-like component of the reversing element, the underflow plate, extends into the organic solution and the organic solution is made to flow through a slotted zone arranged in the upper part of the plate-like component into the rear space of the separation section as several sub-flows.
7. A method according to claim 6, **characterised in that** number of sub-flows is 10 – 100.
8. A method according to one of claims 1 - 7, **characterised in that** the dispersion flow dammed up by means of the first plate-like component of the reversing element is made to flow into the reversing channel from under the first plate-like part.
9. A method according to one of claims 1 - 8, **characterised in that** the dispersion that has flowed to the reversing element is made to flow into the rear space after the reversing element from above the last plate-like part of said reversing element.
10. A method according to one of claims 1 - 9, **characterised in that** at least part of the mixing section is situated inside the separation section, so that the dispersion from the last mixer of the mixing section is directed first towards the front end of the outward flow field

and then reversed by means of picket fences towards the rear of the outward flow field.

- 5 11. A method according to one of claims 1 - 9, **characterised in that** at least one of the solutions separated in the outward flow field is recirculated to the mixing section in the same extraction step.
- 10 12. A method according to one of claims 1 - 11, **characterised in that** the metal to be recovered is one of the metals copper, uranium, cobalt, nickel, zinc or molybdenum.
- 15 13. Equipment for a controlled separation of a dispersion of aqueous solution and organic solution formed in a mixing section (1) into their own phases during metal recovery in a liquid-liquid extraction settler (2), which comprises a feed end (6), rear end (7), sidewalls (8,9), bottom (35) and headboxes (24,26) of separated solutions, **characterised in that** the settler is equipped with two partition walls (10,11) dividing the settler into two sections, substantially parallel to the sidewalls of the settler, where said partition wall divides the settler into an outward flow field (12) and return flow fields (20,21) on both sides of it, and with a reversing element (16) located crosswise in relation to the longitudinal axis of the settler and the ends of the partition walls (10,11), where said reversing element comprises of at least two reverser plates (17,18) situated at different heights.
- 20 25 14. Equipment according to claim 13, **characterised in that** in the rear part of the settler, picket fences (22,23) are located at the front end of the return flow fields (20,21), which are fastened at one end to the end of the partition walls (10,11) and at the other end to the back of the sidewalls (8,9) or to the corner of the sidewalls (8,9) and the rear end (7).
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15. Equipment according to claim 14, **characterised in that** guiding plates are situated behind the slots in the picket fence to reverse the flow.
- 5 16. Equipment according to one of claims 13 - 15, **characterised in that** the length of the partition walls (10,11) is 85 – 95% the length of the settler.
- 10 17. Equipment according to one of claims 13 - 16, **characterised in that** the partition walls (10,11) form an angle of 5 – 15° with the longitudinal axis of the settler so that the cross-section of the flow fields (12,20,21) formed by the partition walls decreases in the direction of flow.
- 15 18. Equipment according to one of claims 13 - 17, **characterised in that** the angle of tapering of the outward flow field (12) is preferably around 15 – 25°.
- 20 19. Equipment according to one of claims 13 – 18, **characterised in that** the first reverser plate of the reversing element, the underflow plate (17), is located higher than the second, the overflow plate (18).
- 25 20. Equipment according to one of claims 13 – 19, **characterised in that** the upper edge of the first reverser plate (17) is located inside the organic solution in the settler.
- 30 21. Equipment according to one of claims 13 – 20, **characterised in that** the distance of the lower edge of the first reverser plate (17) from the bottom of the settler (34) is 15 – 30 % of the solution height of the settler.

22. Equipment according to one of claims 13 – 21, **characterised in that** the reverser plates (17,18) are mainly solid.
23. Equipment according to one of claims 13 – 22, **characterised in that**
5 a slotted zone (28) is formed in the upper edge of the first reverser plate (17) of a distance corresponding to 5 – 25 % of the height of the reverser plate in question.
24. Equipment according to one of claims 13 – 23, **characterised in that**
10 a slotted zone (31) is formed in the lower edge of the first reverser plate (17) of a distance corresponding to 5 – 15 % of the height of the reverser plate in question.
25. Equipment according to one of claims 13 – 18 or 22, **characterised**
15 **in that** a slotted zone (33) is formed in the upper edge of the second reverser plate, the overflow plate (18) of a distance corresponding to 5 – 15 % of the height of the reverser plate in question.
26. Equipment according to one of claims 13 – 18, 22 or 25 ,
20 **characterised in that** the distance of the lower edge of the second reverser plate (18) from the bottom of the settler is 3 – 10% of the solution height of the settler.
27. Equipment according to one of claims 13 – 18, 22 or 25 - 26,
25 **characterised in that** the upper edge of the second reverser plate (18) is placed below the surface of the solution, to a distance that is 20 – 40 % of the solution height of the settler.
28. Equipment according to one of claims 13 – 27, **characterised in that**
30 the reverser plates (17,18) of the reversing element are placed in the settler at a 10 – 30 ° angle to the vertical.

29. Equipment according to one of claims 13 - 28, **characterised in that** the upper edge of the reverser plates (17,18) is inclined towards the feed end (6) of the settler.
- 5 30. Equipment according to one of claims 13 – 29, **characterised in that** in front of the upper part of the slotted zone (33) of the second reverser plate (18) of the reversing element there is located a solid blocking plate (37) in the same direction as the reverser plate, and that the vertical position of said blocking plate can be changed using
10 its support elements (38).
31. Equipment according to one of claims 13 – 30, **characterised in that** the headboxes (24,26) of the settler are located in front of the return flow fields (20,21) at the feed end (6) of the settler.
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32. Equipment according to one of claims 13 – 31, **characterised in that** the mixing section (1) is located in front of the outward flow field (12) of the settler.
- 20 33. Equipment according to one of claims 13 – 31, **characterised in that** the mixing section (1) is located at least partially inside the outward flow field (12).
- 25 34. Equipment according to claim 33, **characterised in that** the mixers (4,5) of the mixing section (1) are located inside the outward flow field (12).
- 30 35. Equipment according to claim 34, **characterised in that** the outward flow field (12) is equipped with a two-part picket fence (15), of which the first part extends from the first mixer (4) to the nearer partition wall (10) and the second section from the second mixer (5) to the partition wall nearest to it (11).

36. Equipment according to one of claims 13 – 35, **characterised in that** the outward flow field (12) is equipped with at least one picket fence (13,14), which when seen from above forms a gentle zigzag shape.
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37. Equipment according to one of claims 13 – 36, **characterised in that** the outward flow field (12) is equipped with at least one separated solution collection channel (41,42), situated close to the rear end.
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38. Equipment according to claim 37, **characterised in that** the outward flow field (12) is equipped with at least one collection channel (41,42), and pipelines (43,44) connected to it/them for directing the separated solutions to the pump tank (3) in the same extraction step.